

Picometer-Resolution MEMS Segmented DM, Phase I

Completed Technology Project (2011 - 2011)



Project Introduction

Microelectromechanical systems (MEMS) technology has the potential to create deformable mirrors (DM) with 10^4 actuators that have size, weight, and power specifications that are far lower than conventional piezoelectric and electrostrictive DMs. However, building a MEMS DM with a relatively large aperture that is flat in the unpowered state is challenging. Currently, a large portion of the mirror stroke must be used to flatten the MEMS DMs and in some cases, the DM stroke is not even sufficient to flatten the mirror. In the case of the large-stroke segmented MEMS DMs manufactured by Iris AO, there is sufficient stroke for wavefront correction after flattening. However, the resolution is significantly reduced because the dynamic range of the digital-to-analog converters (DAC) used to operate the DM is spread over multiple microns of stroke rather than the $0.5\text{ }\mu\text{m}$ range required to correct for aberrations in the telescope that feeds the coronagraph. This Phase I SBIR will make substantial improvements in the fabrication process of MEMS segmented DMs that reduce the deleterious residual surface-figure errors. It will do so by systematically addressing the sources of the segment position variations as well as addressing low-spatial frequency chip bow that can result in large peak-to-valley deformations across the DM array. The Iris AO DM architecture will also be modified to enable picometer resolution actuation with ultra-precision drive electronics.

Primary U.S. Work Locations and Key Partners

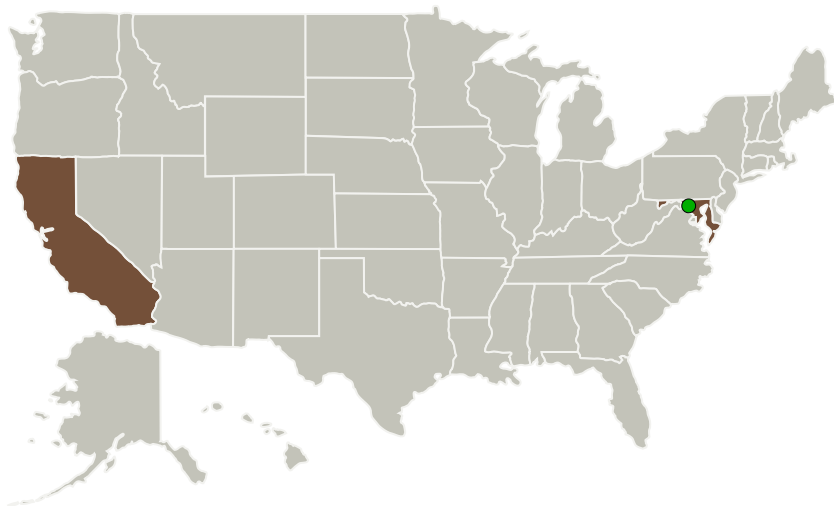
Picometer-Resolution MEMS
Segmented DM, Phase I

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3

Picometer-Resolution MEMS Segmented DM, Phase I

Completed Technology Project (2011 - 2011)



Organizations Performing Work	Role	Type	Location
Iris AO, Inc.	Lead Organization	Industry	Berkeley, California
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
California	Maryland

Project Transitions

**February 2011:** Project Start**August 2011:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/140162>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Iris AO, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Michael A Helmbrecht

Co-Investigator:

Michael Helmbrecht

Picometer-Resolution MEMS Segmented DM, Phase I

Completed Technology Project (2011 - 2011)



Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.2 Observatories
 - └ TX08.2.1 Mirror Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System